Math 115
Worksheet Section 3.9

Warm-up question

The linear approximation or local linearization of $f(x)$ at $x = a$ is given by $L(x) =$_____

Problem 1. (a) Find the linear approximation of $\ln(x)$ at $x = 1$.

(b) Use your approximation to approximate $\ln(1.1)$

(c) Is your answer an underestimate or overestimate of $\ln(1.1)$? Why?

Problem 2. Find the linear approximation of $\cos(x)$ at $x = 0$.

Problem 3. (Winter 2017 Exam 2) A group of biology students is studying the length L of a newborn corn snake (in cm) as a function of its weight w (in grams). That is, $L = G(w)$. A table of values of $G(w)$ is shown below.

w	5	10	15	20	25
$G(w)$	24.5	31.6	38.7	44.7	50
$G'(w)$	2.23	1.58	1.30	1.12	1.05

Assume that $G'(w)$ is a differentiable and decreasing function for $0 < w < 25$.

(a) Find a formula for $H(w)$, the tangent line approximation of $G(w)$ near $w = 20$.

(b) Use the tangent line approximation of $G(w)$ near $w = 20$ to approximate the length of a corn snake that weighs 22 grams.

(c) Is your answer in part (b) an overestimate or an underestimate? Write a sentence to justify your answer.

(d) In their study of the growth of corn snakes, they found the results of a recent article that states that the average weight w of a corn snake (in grams) t weeks after being born is given by $w = \frac{1}{5}t^2$. Let $S(t) = G(\frac{1}{5}t^2)$ be the length of a corn snake t weeks after being born. Find a formula for $P(t)$, the tangent line approximation of $S(t)$ near $t = 5$.

Problem 4. (Fall 2016 Exam 2) Let $h(x) = x^x$. For this problem, it may be helpful to know the following formula:

$$h'(x) = x^x(\ln(x) + 1)$$

Write a formula for $p(x)$, the local linearization of $h(x)$ near $x = 1$.

Problem 5. (Fall 2017 Exam 2) Let g be a twice differentiable function defined on $-1 < x < 11$. Some values of $g(x)$, $g'(x)$ and $g''(x)$ are shown in the table below.

x	0	2	4	6	8	10
$g(x)$	-2	-1	3	4	5	6
$g'(x)$	0.5	2	?	5	1	2
$g''(x)$	2	1	5	-3	-1	0.5

Let $j(x) = g(14 - 4x)$.

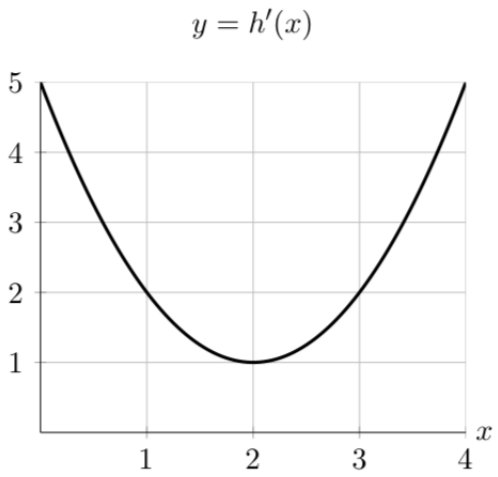
(a) Use the values from the table to find a formula for $L(x)$, the linear approximation to $j(x)$ at $x = 2$.

(b) Find an approximate value for $j(2.25)$ using your formula for $L(x)$.

(c) Is your approximation in part (b) an overestimate or an underestimate? Circle your answer and give a justification of your answer.

Overestimate Underestimate Not enough information

Problem 6. (Winter 2018 Exam 2) Below is the graph of $h'(x)$.



(a) Find a formula for the tangent line approximation $L(x)$ to the function $h(x)$ near $x = 2$ if the point $(2, -3)$ lies on the graph of $y = h(x)$. Your answer should not include the letter h.

(b) Use the tangent line approximation to $h(x)$ near $x = 2$ to approximate the value of $h(1.6)$.

(c) Is your approximation in part (b) an overestimate, an underestimate or is there not enough information to determine that?